

REMARKS

Amendments to the Claims

Claim 31 has been amended to add a word inadvertently left out (controlled) when this claim was previously amended. New claims 47 and 48 are added, adding the limitation from original claim 11 (currently pending claim 40) to claims which depend from claims 11 and 31, respectively, and removing reference to alkene products. Support for new claims 47 and 48 is found in the Examples, elsewhere throughout the specification, and in the original claims.

Rejections Under 35 USC §103(a)

The Examiner has withdrawn the indication of allowability of claim 11 and newly rejected all the claims as unpatentable over Sun (US6,046,373, hereinafter "Sun 1") alone, or in view of Sun et al. (US5,925,800, which the Examiner mistakenly cites as US 5,962,800 - See Office Actions of December 5, 2005 and July 12, 2006) - hereinafter "Sun 2") and further in view of Mao (US 5,780,689). The Office Action asserts that "Sun teaches a process to convert oxygenates to olefins or ethers in the presence of heterogeneous catalysts, which have been modified..." (see Office Action, p. 2).

The Examiner is correct in noting that Sun 1 teaches *modification of the catalyst* in the presence of electromagnetic energy, not *conversion of the oxygenates* to olefins (See Office Action, p. 5), and that even if true, the pending claims do not exclude use of electromagnetic energy. However, the conclusion that the instant claims are not patentable over Sun 1 is not correct. Sun 1 is directed almost entirely to the preparation of a modified catalyst, but does disclose the use of the catalyst for production of olefins from oxygenates, and Sun 1 does disclose carrying out this reaction under supercritical conditions. However, there are absolutely no examples in Sun 1 using supercritical conditions for the disclosed reactions, and indeed, the only remotely relevant example in Sun 1 is to the conversion of methanol to olefins under *non-supercritical* conditions. See, e.g., col. 8, lines 17-19, where Sun 1 teaches that under conditions *not suitable* for producing olefins, as understood by one of skill in the art - where the oxygenate feed comprises mainly alcohols - ethers *may* become the major product (emphasis added).

Applicants submit that while it appears, *prima facie*, that Sun 1 is relevant to the pending claims, a deeper look suggests this is not a valid assumption. The thrust of the present application is to the *selective* production of ethers, acetals, ketals and alkenes from alcohols under supercritical or near critical conditions. In other words, the process of the present invention is seeking to obtain discreet olefins from a number of possible olefin products, discreet ethers from a number of possible ether products, discreet acetals or ketals from a number of possible acetal or ketal products, using discreet conditions. The processes described in Sun 1 are not selective with respect to product or conditions. Sun 1 is selective only in the broadest sense, in that the disclosed process in Sun 1 produces olefin reaction products, generally, as opposed to non-olefin reaction products, generally. Importantly, there is nothing in the teachings of Sun 1 that would lead the skilled person to believe that at super critical or near critical conditions, selectivity for a desired olefin from a number of possible olefin products can be obtained, likewise between, a specific acetal, ketal or ether, from a number of possible acetal products, possible ketal products and possible ether products, respectively. Note the following references in Sun 1 which point towards non-selectivity within a target category of products:

- Column 6, lines 14-16: "in the oxygenate conversion process, the oxygenate feed is converted to the olefin at a desired rate under conditions effective to reach a desired selectivity to olefins".
- Column 6, lines 17-19: "the conversion of the oxygenate feed is at least about 70% and the combined selectivity to all olefins is at least about 50% of the converted oxygenate...."
- Column 7, lines 43-44: "effective process conditions so as to produce the desired olefins".
- Column 8 lines 17-19: "When the oxygenate feed comprises mainly alcohols, ethers may become the major products under conditions not effective or sufficient to produce olefins".

Applicants also respectfully submit that one skilled in the art of the chemistry of acid-catalyzed reactions would appreciate that the teachings of Sun 1, at least in respect of the preparation of

olefins, is effectively a de-oxygenation or cracking reaction, in contrast to the reaction for the preparation of ether disclosed in the present application, which is a convergent synthesis.

Developing catalysts and modifying reaction conditions to obtain one particular product molecule from a particular substrate out of a group of possible product molecules from that substrate is unpredictable and difficult. Reactions do not “behave” as expected the majority of the time, and it is often nearly impossible to assume that reaction conditions for converting one substrate into a desired product will yield similar results for a related but different substrate. In the present case, Applicants have unexpectedly discovered that supercritical or near critical conditions, when used in conjunction with specific catalysts, lead to selective production of specific olefins, ketals and acetals from a given alcohol, out of the numerous possible olefins, ketals and acetals that are known to form from the starting alcohol.

Sun 1 does not teach *selective* production of a *specific* olefin, acetal or ketal product from a given alcohol using supercritical or near critical conditions. Sun 1 merely discloses a number of catalysts that are useful in producing olefins from alcohols, generally (as opposed to producing non-olefins), and notes in passing that “alternatively, the process may be carried out in a liquid, supercritical fluid... or a mixed vapor/supercritical fluid phase.” See Sun 1, col. 7, lines 47-49. In the present case, the disclosed processes using supercritical and near critical conditions coupled with heterogeneous acid catalysts lead to “surprisingly high yields and/or selectivities”, and products that have not undergone “any significant rearrangement” (see WO application, p. 1, line 23 through p. 2, line 6; p. 4, lines 27-29; p. 9, lines 7-21 and lines 26-32; the Examples 1-6 on pp. 11-15 and the tabulated yields; and in original claim 11).

There is no reasonable expectation of success in producing selective products using the process of Sun 1, because nothing in Sun 1 suggests that supercritical fluids are preferable to other reaction conditions, or that selectivity within a product class can be achieved by preferentially using supercritical conditions. There is no motivation to select supercritical fluids, mentioned in passing in Sun 1, from all the various reaction conditions disclosed as suitable in Sun 1 (see col. 7, lines 40-52), unless one wants to form olefins “not necessarily in optimum amounts” (see col. 8, lines 1-2) or be content with the prediction that at upper and lower pressure extremes which “may adversely affect selectivity” ... light olefins ... still *may* form.” See col. 8, lines 13-16, emphasis added. In fact, Sun 1 prefers the vapor phase (see col. 7, lines 40-45).

Moreover, Sun 1 provides no incentive to use heterogeneous acid catalysts in a continuous flow reactor specifically, as recited in pending claim 11. Sun 1 lists numerous possible choices for a reactor, including a fluidized bed reactor, a circulating fluid bed reactor with continuous regeneration, a riser reactor, a fixed bed reactor, or a moving bed reactor, with no stated preference for any (see col. 8, lines 53-57).

As recited in MPEP § 2142, a *prima facie* case of obviousness requires that the reference or combination of references teach or suggest all claim limitations, that there be motivation to combine or modify the reference (or combination) in the references themselves or the knowledge generally available in the art, and that there be a reasonable expectation of success. In the present case, the selectivity and lack of rearrangement in products achieved using supercritical or near critical conditions with heterogeneous acid catalysts in a continuous flow reactor are unexpected and not predicted by the teachings of Sun 1. There is nothing in Sun 1 to suggest using either the supercritical conditions over other disclosed conditions, *or* using a continuous flow reactor over the other reactors disclosed, independently, let alone a suggestion to use *both* supercritical conditions *and* a continuous flow reactor with heterogeneous acid catalysts for selectively converting alcohols to a given product. And given the caveats in Sun 1 that such choices for reaction conditions (i.e. supercritical conditions) may negatively affect yield and result in olefin products "not necessarily in optimum amounts" (see col. 8, lines 1-5) Sun 1 merely shows that there is also no reasonable expectation of success for producing products "selectively formed in high yield with insignificant rearrangement", as required by claims 40, 47 and 48.

For at least these reasons, Applicants respectfully submit that the pending claims are not obvious with respect to Sun 1. Withdrawal of the obviousness rejection based on Sun 1 is therefore requested.

The Examiner further rejects claims 11 and 31-46 in view of Sun et al. (hereinafter "Sun 2") and Mao in combination with Sun 1 (see Office Action, p. 2). However, neither of these references is at all concerned with carrying out reactions at supercritical or near critical conditions. Sun 2 deals with processes for the production of catalysts for conversion of oxygenates to olefins, generally, under non-supercritical conditions. The basis of Sun 2 is to use a non-zeolite catalyst (example is silicoaluminophosphates, "SAPOs") coated on an inorganic

monolithic support. Low surface area supports are preferred and the examples are glass, metals, and enamel, porcelain, fused alumina, fused silica and several more. The only examples are the conversion of a methanol/water mixture to carbon dioxide and hydrogen. The Examiner uses Sun 2 to teach that the performance of zeolitic catalysts and certain non-zeolitic catalysts in the conversion of oxygenates to light olefins can be improved by using monolithic supports.

However, it is important to bear in mind that near critical and supercritical conditions are so far removed from "normal" reaction conditions that there is little predictability in relation to the behavior of a given entity in either set of conditions. Thus, the skilled person could not simply assume that because an advantage is achieved with a particular catalyst treatment for a given reaction in normal conditions, a comparable improvement might be obtained for a similar (but different) reaction at near critical or supercritical conditions.

Parallel arguments apply in respect to Mao. Mao is concerned with a process for producing methyl t-butyl ether (MTBE) by catalytic reaction of methanol and isobutene in the presence of an acidic catalyst. Mao acknowledges a prior art process using a ZSM-5 zeolite treated with trifluoromethanesulfonic acid (aka TFA, triflic acid). The improvement in Mao is to use an acid form Z zeolite, i.e. a Y zeolite treated with TFA.

Mao is *not* concerned with carrying out reactions at critical or near critical conditions. The Examiner is citing Mao only to show that it would have been obvious to treat a catalyst with a sulfonic moiety to increase surface acidity. Again, the skilled person would understand the advantages this might provide at normal conditions, but this does not mean that a corresponding advantage would be achieved at near critical or supercritical conditions. The reaction environments are simply not comparable. For example, at supercritical or near critical conditions, the sulfonic acid moiety is not likely to be ionized, in contrast to its likely state in normal reaction conditions.


And, as detailed above, Sun 1 alone does not render the pending claims obvious because there is no suggestion to use the particular reaction conditions (supercritical) and reactor (continuous flow) with heterogeneous acid catalysts recited in the pending claims, and because there is no reasonable expectation of success for achieving the surprising results of products "selectively formed in high yield with insignificant rearrangement" as recited in claims 40, 47 and 48, if one uses supercritical conditions, according to Sun 1 (see col. 8, lines 1-5). Therefore,

combining Sun 1 with Sun 2 and Mao, neither of which deal with near critical or supercritical conditions, does not eliminate the failing of Sun 1 to render the pending claims obvious, because neither Sun 2 nor Mao provides motivation to use near critical or supercritical conditions, and neither provides motivation to use a continuous flow reactor with heterogeneous acid catalysts coupled with the near critical or supercritical reaction conditions recited in the pending claims. Therefore, the combination of Sun 1 with Sun 2 and Mao, like Sun 1 alone, does not support a *prima facie* case of obviousness and the pending claims are not obvious.

CONCLUSION

In view of the above-arguments, Applicants respectfully request withdrawal of the claim objections and obviousness rejections under 3 USC § 103(a), and submit that all claims are in condition for allowance. Reconsideration of the claims and a notice of allowance are therefore requested.

Applicants believe that a three-month extension is required, and therefore that \$510 be charged to deposit account 19-4972 to cover the three-month extension fee. However, in the event that additional fees are due for the timely consideration of this application, Applicants request that any necessary fees be charged to Deposit Account No. 19-4972.



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